Uncertainty Guidelines

National Climate Assessment Development and Advisory Committee

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Objective and Context

- Provide guidelines for authors of the NCA regarding approaches for evaluating and describing levels of confidence and likelihood
- Systematic approach to users' question of "how 'reliable' is your information?"
  - Question to users: "For what purpose?"
- Based on IPCC uncertainty guidance and other sources (e.g., Morgan et al., CCSP 2009)

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Design Criteria

- Appropriate for impacts, adaptation, vulnerability assessment and US audiences
- Reflect current view of “best practice” in the decision analysis and risk communication field
- Compatibility with IPCC approach
- Practical, conveyed in a short, to-the-point, document

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Status

- Initial NCADAC discussion in August
- Drafts prepared & revised August-November
  - Inputs from authors and experts
- For discussion at November 15 meeting of NCADAC ad hoc working group on scenarios and request for approval by NCADAC during November 16-17 meeting

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Checklist for Major Conclusions

- Apply process to ~3-6 key conclusions in each technical report or chapter
- Checklist to help remind authors of key steps

Brief statement of conclusion, referenced to report or chapter:
1. Framing and stakeholder information needs Identify relevant stakeholders and their views/roles. Fully Partially Limited extent
2. Initial evaluation of evidence Evaluate type, amount, quality, and consistency of evidence. Strong Fair Weak
3. Application of information and preparation of conclusions Incorporate diverse science-based perspectives, estimate 90 percent confidence interval, describe important outliers, then provide best estimate if appropriate. Fully Partially Limited extent
4. Key uncertainties identified Evaluate sources of uncertainty, e.g., limited data, process knowledge gaps, incomplete models, inherent variability of the system, etc., and identify how additional monitoring, research, etc., will improve information base. Fully Partially Limited extent
5. Confidence assessed using evidence and agreement Agree on a confidence level, recognizing that different combinations of factors affecting evidence and agreement will influence your confidence. High Med High Med Low Low
6. Likelihoods estimated for potential high consequence outcomes Estimate likelihood using evaluation of model results, statistical sampling methods, other quantitative analyses, elicitations, or expert judgment. Yes No
7. Traceable account included to describe factors that contributed to conclusion and level of confidence Describe reasoning, evidence used, scenario assumptions, etc. Yes No

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Step 1: Issue Identification

- *Frame a manageable number (3-4) of key questions or issues that address the most important information needs of stakeholders*
  - Consider these as key points you will include in an executive summary
  - Consult stakeholders directly or by review of prior assessments that engaged stakeholders
    - Note: technical inputs will have more opportunity to interact with stakeholders than NCA authors

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Step 2

- *Evaluate the available information, considering the type, amount, quality, and consistency of evidence*
  - What kind of information is available?
  - How much information is available?
  - How good is the information?
  - How consistent is the information?
- This initial evaluation will help define approach and level of precision

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Step 3

- *Formulate well-posed conclusions that can be confirmed or falsified*
  - Incorporate diverse science-based perspectives and information of sufficient quality
  - Be aware of a tendency for assessment teams to converge on a conclusion and become overconfident in it
  - For quantitative estimates, estimate the 90 percent confidence interval

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Step 4

- *Identify key* uncertainties and briefly describe observations and research needed to improve the information
  - Consider how uncertainties affect information for decision making
  - Not all uncertainties will have significant effects on estimates of outcomes, costs, or risks

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Step 5

- *Assess confidence by considering (i) the quality of the evidence and (ii) the level of agreement among experts with relevant knowledge and experience*
  - Subjective process but must be based on systematic evaluation of the type, amount, quality, and consistency of evidence and the degree of agreement among experts
  - Different combinations of factors can be associated with each confidence level

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Confidence Scale

	Confidence Level	Combinations of factors that could contribute to this confidence evaluation
	High	Strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus
	Medium High	Fair evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus
	Medium Low	Fair evidence (a few sources, limited consistency, models incomplete, methods emerging, etc.), competing schools of thought
	Low	Weak evidence (limited sources, extrapolations, inconsistent findings, poor documentation and/or methods not tested, etc.), disagreement or lack of opinions among experts

Credit to Dan Albritton for confidence metric

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Step 6

- *Especially for findings that identify potential high consequence outcomes (see risk framing approach), estimate the likelihood of occurrence*
  - Provide a likelihood that the outcome could occur under a stipulated scenario or conditions
  - Use the standardized ranges on next slide
  - Basis: evaluation of model results, statistical sampling methods or other quantitative analyses, elicitations, or expert judgment

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Optional Standardized Likelihood Ranges

- Use thee ranges INSTEAD OF terms such as "likely", "very likely", "possible", etc.

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Step 7

- *Prepare a summary "traceable account"* (a few sentences to a paragraph)
  - Describe main factors influencing level of confidence, e.g., the evidence used, its quality, ranges of estimates, interpretations in the literature, assumptions, and the level of agreement
  - Specify the scenario of climate change used
  - Consider preparing a more extended traceable account in an appendix

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Additional Resources Under Development

- Written guidelines alone are insufficient to standardize uncertainty characterization
  - IPCC experience
- Resources are under development to:
  - Add experts in decision analysis and risk communication to key chapters
  - Undertake expert elicitations for ~6 key issues
  - Conduct an evaluation of the approach
- Resources and volunteers sought

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Expert Elicitation

- Structured elicitation of informed judgment has substantial precedent as a basis for augmenting sparse or ambiguous data
  - Widely applied in engineering and environmental risk analyses
  - Uses participants as surrogates for the wider technical community
  - Usually time consuming and costly (especially if multiple experts must be interviewed)
- Multiple steps in the process are designed to address systematic biases and to produce a distribution that the experts agree properly represents their state of information

Candidate Issues for Elicitation

- Water resources
- Coastal areas
- Crops and livestock
- Extreme precipitation and flooding in river basins (Missouri, Connecticut Sacrameto, ...)
- North Atlantic hurricanes
- Great Lakes levels
- Ice-on, ice off, snowfall for NE
- Tornados – basis for informed judgment?
- Future dryness in mid-continent
- Wildfire
- Forest dieback
- Ocean temperature change and distribution of marine life
- Coral reef die-back (ocean acidification, temperature, runoff, …)
- Others?

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Discussion